

**Refractory plate for a device for the insertion and/or removal of a nozzle for a casting installation combined with a sliding plate flow-control device.**

[0001] The present invention relates to a refractory plate for a device for the insertion and/or removal of a nozzle for a casting installation combined with a sliding plate flow-control device.

[0002] The casting of a melt is generally carried out with an installation comprising several refractory elements forming a casting channel between two consecutive metallurgical containers.

These elements fulfill different functions which are the transfer of the melt, the protection of the melt against cooling and the chemical attacks of the surrounding atmosphere and, optionally, the control

of the melt casting flow. Thus, in the continuous casting, the melt contained in a casting ladle is poured through a discharge orifice arranged in the bottom wall of the ladle and prolonged by a nozzle extending through the bottom wall. Under the bottom wall, there is generally a device for the flow-control of the liquid metal stream, the device being constituted from refractory plates provided each with a casting orifice which can be aligned or shifted one with respect to the other by the

relative displacement of the plates so as to modify the cross-sectional flow area defined by the superposition of the pouring orifices. The melt exits from the flow-control device into a nozzle, having generally a small length and called collector nozzle. The most often, a casting tube intended for shrouding the stream discharged from the collector nozzle during its way to a tundish is provided. Conventionally, this shroud is fitted on the downstream end of the collector nozzle. From the USP 5,695,674, a casting installation wherein the collector nozzle and the shrouding nozzle form an assembly introduced into the casting position by sliding into guide-rails is however also known. The International patent application WO-A1-9920420 discloses such a shrouding tube.

[0003] The metal poured through the shrouding tube into the tundish is then directed towards one or more pouring orifices arranged in the bottom wall of the tundish. This orifice is prolonged by a nozzle which can run directly into the ingot-mold. In this case, the flow-control of the melt poured from the tundish is performed with a stopper system which can close the pouring orifice arranged in the bottom wall. In a variant, the nozzle can be formed of several adjacent elements, in particular, an inner nozzle ending upstreamly with the pouring orifice arranged in the bottom wall and downstreamly with an end formed as a plane surface and a subentry nozzle ending upstreamly with

a plane surface matching the plane surface of the inner nozzle. Such an installation allows the replacement with an appropriate device (such as described for example in the patent EP-A1-192,019) of the subentry nozzle without having to interrupt the casting. In this case also, the flow-control of the melt poured from the tundish is performed with a stopper system which can close the pouring orifice arranged in the bottom wall. Another variant wherein a flow-control device with plates working according to the same principle as the flow-control device above described in the context of the casting ladle is inserted between the inner nozzle and the subentry nozzle is also known. The patent EP-B1-441,927 discloses such a kind of installation.

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[0004] The present invention relates more particularly to an installation comprising a device for the insertion and/or removal of a nozzle for a casting installation combined with a sliding plate flow-control device.

5 [0005] The possibility to insert and/or to exchange a nozzle during the casting without having to interrupt it has been mentioned hereabove. The pouring nozzle intended to lead the melt from a metallurgical container towards another one are indeed wear parts which are strongly mechanically, chemically and thermally stressed to an extent that their service life can limit the casting time. In this context, there are many problems that the invention propose to solve with the plate according to the present invention.

10 [0006] Indeed, the lower plate of the sliding plates flow-control device is also the stationary plate of the device for the insertion and/or removal of a nozzle for a casting installation combined with a sliding plate flow-control device against which the nozzle is brought from an insertion position towards a casting position by the device for the insertion and/or removal. These two functions impose hardly reconcilable requirements:

15 - the lower plate of the sliding flow-control device must rest in a housing supporting it at most so as to provide a perfect seal between its upper face and the matching surface of the mobile plate of the flow-control device,

but, at the same time,

20 - its lower face must permit to guide the nozzle during its displacement from the introduction position towards its casting position.

[0007] If the plate is not enough supported into its housing, the plate is indeed not homogeneously supported. In particular, the pressure is not uniformly distributed around the pouring orifice of the plate and an incident called "finning" consisting in the formation of a thin strip of frozen metal between the stationary plate and the mobile plate, can take place. If this incident occurs repeatedly, 25 the frozen metal strip acts as a wedge and push apart the two plates. It can even end with an infiltration of molten metal which cause the immediate termination of the casting operations.

[0008] If the guiding surface is not sufficient to permit a correct guiding of the nozzle from the introduction position towards the casting position, the risk to have this casting nozzle in an incorrect position is important with all the adverse consequences that one can imagine.

30 [0009] Moreover, for economical reasons, it is important that the refractory plates have as low as possible dimensions, in, in particular as to its thickness. However, the casting channel extending through the lower pate of the sliding plate flow-control device is subjected to a very strong erosion due to the turbulent and asymmetrical molten metal stream passing through it. In particular, it is essential to prevent the metal stream so deviated (unbalanced) to hit the casting channel wall in the vicinity of its exit orifice, otherwise, the risk to damage the seal formed by the contact with the 35 adjacent refractory element around the orifice of the casting channel would be great.

[0010] The inventors have thus seek to solve these problems and have come to the idea of providing the plate in question with a protuberance. Even so, its shape still had to be optimized so as to solve the above mentioned problems.

[0011] In order to permit a better understanding of the invention, it will now be described on the basis of the illustrative figures, which however do not limit it in any way. On these figures, top views of two different refractory plates according to the invention have been depicted on figures 1 and 1a. Figures 2 and 2a show two cross-sectional views according to the line A-A respectively of figure 1 and 1a. Figure 3 shows a cross-sectional view according to the line B-B of figure 1. Figures 4 and 4a show perspective views from the lower face of the plates respectively of figure 1 and 1a.

[0012] According to the invention, the refractory plate for a device for the insertion and/or removal of a nozzle for a casting installation combined with a sliding plate flow-control device comprises the following elements:

a) a first surface (1) provided with an orifice (2) defining the entry of a casting channel (3) through the plate and able to form a sealing surface, at least around the orifice (2), with a face matching the face of a mobile plate of the flow-control device;

b) a second surface (4) adapted to rest in housing of the device and provided with a plane protuberance (5) circumscribing the casting channel (3) and extending through the bottom wall of the housing, and

c) a third surface (6) defined by the plane surface of the protuberance (5) provided with an orifice (7) defining the exit of the casting channel (3) through the plate. It is essential that the surface (6) be adapted

- to form a sealing surface, at least around the orifice (7), with a matching face of a refractory nozzle

in casting position, and

- to act as guiding surface for the refractory tube from an introduction position to a casting position, and being shaped so that the portion of the third surface (6) of the plate in contact with the matching surface of the refractory tube increases as the tube progresses from the introduction position to the casting position.

[0013] With this plate, an optimal compromise between the necessity to support at most the lower part of the plate while maximizing the lower surface available for guiding the tube from its introduction position to the casting position.

[0014] The preferred shape for the protuberance is a tip shape, the tip (8) being directed towards the introduction position of the refractory tube. Henceforth, the initial efforts required to move the tube from its introduction position are quite low and increase progressively as the tube moves closer to its casting position. In case the tube is not perfectly aligned in the nozzle insertion and/or removal device, this particular shape allows an adjustment of the tube during its progression in the device.

[0015] Particularly suitable shapes are the oval, triangle, or egg shapes. The egg shape (see on the figures 1, 1a, 4 and 4a) permitting to avoid sharp angles and maximizing the above described effect is particularly preferred.

[0016] The presence of a chamfer at the end of the tip (8) strengthens even more this advantageous effect.

[0017] Alternatively, it is also possible to have a chamfer on the opposite end of the tip (8). This is particularly advantageous when it is necessary to bring to the casting position, or to any other

appropriate position, another tube or any other refractory element which has to be introduced from a direction opposite to the tube introduction direction. For example, this can be a collector nozzle which would be parked in a waiting position on the other side of the device.

[0018] The plate according to the invention can or not be provided with a metallic envelope.

5 [0019] If it is desired to protect the metal stream from the ambient atmosphere likely to contaminate the molten metal stream by passing through the seal either around the entry orifice (2) between the surface (1) and the lower surface of the sliding plate flow-control device or around the exit orifice (7) of the surface (6) and the upper surface of the tube, it is also possible to provide means permitting the formation of an inert gas shrouding channel circumscribing the orifice to  
10 protect. For example, one can have an inert gas line (9) feeding a circular groove (10) circumscribing the exit orifice (7) in the third surface (6) as depicted on the figures 1 to 4. A groove similar of or any other kind can be present around the orifice (2).

[0020] Eventually, according to another advantageous variant of the invention, a second passage (12) extending through the plate from an orifice (11) of the third surface (6) towards an orifice (13) of  
15 the first surface (1) is provided. Preferably, this second passage (12) will have smaller dimension than the casting channel (3) and will be localized far from the casting channel (3), for example close to the end of the tip (8). This embodiment is depicted on figures 1a, 2a and 4a.

[0021] In case it is not possible to start naturally the casting sequence, just by opening the flow-control device, it is then possible to bring this second passage in register with the casting channel of  
20 the mobile plate and to introduce, through the passage (12) and the orifices of the downstream refractory elements a lancing device which will allow, for example by oxygen lancing to free the casting channel from any obstruction. In this case, it can be useful to position a collector nozzle (11) under the orifice (11) or to have a refractory provided with means allowing the access to the casting channel passing through the refractory plates.